DRAFT. June 11, 2014

Water Quality Standards and Numeric Targets

The Washington State water quality standards, set forth in Chapter 173-201A of the Washington Administrative Code (WAC), are the basis for protecting and regulating the quality of surface waters in Washington State. The State's water quality standards include:

- Designated uses such as fishing, swimming, and aquatic life habitat.
- Numeric and narrative water quality criteria limits to protect the uses.
- Policies, such as antidegradation, to protect higher quality waters from being further degraded.

This section provides Washington State water quality information and those standards applicable to the South Fork Nooksack River watershed.

In July 2003, Ecology made significant revisions to the state's surface water quality standards (Chapter 173-201A WAC). These changes included restructuring the system that the state uses to designate uses for protection by water quality criteria (e.g., temperature, dissolved oxygen, turbidity, bacteria). Ecology also revised the numeric temperature criteria assigned to waters to protect specific types of aquatic life uses (e.g., native char, trout and salmon spawning and rearing, warm water fish habitat).

Commented [cb1]: Stephanie, I removed the edit you made here and in the following paragraph. We actually did adopt these changes into rule prior to submitting to EPA for approval.

Ecology submitted the revised water quality standards regulation to EPA for federal approval in July 2003. EPA approved the majority of the revised standards on February 11, 2008. The revisions to the existing standards are online at Ecology's water quality standards website: www.ecy.wa.gov/programs/wq/swqs.

Segments of South Fork Nooksack River and its tributaries are identified on the Washington State 2010 303(d) list as being impaired by excess temperature. Temperature affects the physiology and behavior of fish and other aquatic life, ~~as well as~~ it also impacts the physical and biological properties of the ~~water body~~waterbody. For example, higher stream temperatures are generally associated with lower levels of dissolved oxygen in the water. Temperature is an influential factor limiting the distribution and health of aquatic life and can be greatly influenced, ~~in turn,~~ by human activities.

Temperatures in streams fluctuate over the day and year in response to changes in solar energy inputs, meteorological conditions, river flows, groundwater input, and other factors. Since the health of aquatic species is tied predominantly to the pattern of maximum temperatures, Washington's water quality criteria are expressed as the highest 7-day average of the daily maximum temperatures (7-DADMax) occurring in a ~~water body~~waterbody. The 7-DADMax metric was determined by scientists involved in the development of EPA's Region 10 Guidance for Pacific Northwest State and Tribal

Temperature Water Quality Standards (2003[1]) to include an adequate magnitude and duration (averaging period) to protect salmonids. ~~Since~~ The 7-DADMax temperatures represent conditions in the ~~bulk~~ thalweg or main stream ~~segment~~channel, therefore it is assumed that aquatic species ~~also~~ have access to cold water refugia where they can reside in water ~~that~~ that is cooler than the 7-DADMax temperatures. The 7-DADMax temperature~~s~~ criterion also assume that colder temperatures are available to protect fish at night.

In the water quality standards, aquatic life use categories are described using key species (e.g., salmonid or char versus warm-water species) and life-stage conditions (e.g., spawning versus rearing) [WAC 173-201A-200]. The temperature criteria established to protect these uses are described in Table 200 (1)(c) of the water quality standards and include numeric criteria of 12 °C for Char Spawning and Rearing; 16 °C for Core Summer Salmonid Habitat; both of which are effective throughout the entire year. The 13 °C supplemental standard for spawning and incubation protection of salmonid species (WAC 173-201A-200 (1)(c)(B)(iv)) is effective seasonally from early fall to late spring (exact dates are specific to each stream)~~September 1 to July 1~~ (Ecology, 2011). Temperatures are not to exceed the criteria at a probability frequency of more than once every 10 years on average (WAC 173-201A-200 (1)(c)(iii)).

Special consideration is also required to protect spawning and incubation season of salmonid species. Where it has been determined that the lower temperatures are necessary ~~criteria established for a water body~~waterbody ~~would likely not result in~~ to protect~~ive~~ spawning and incubation ~~temperatures~~, the following criteria apply: (A) Maximum 7-DADMax temperatures of 9 °C (48.2 °F) at the initiation of spawning and at fry emergence for char; and (B) Maximum 7-DADMax temperatures of 13 °C (55.4 °F) at the initiation of spawning for salmon and at fry emergence for salmon and trout. Currently, Chapter 173-201A WAC specifies portions of 7 watersheds in the Columbia River Basin that require these more protective criteria, (Ecology Publication 06-10-038)

While the criteria apply throughout a ~~water body~~waterbody, there may be site-specific features, including shallow, stagnant, eddy pools where natural features unrelated to human influences are the cause of not meeting the criteria. For this reason, the standards direct that ~~one take~~ measurements are taken from well-mixed portions of rivers and streams. For similar reasons, samples are not to be taken from anomalously cold areas such as at discrete points where cold groundwaters flow into the ~~water body~~waterbody.

For the area of the South Fork Nooksack River Watershed covered by this TMDL, the designated aquatic life uses to be protected are *core summer salmonid habitat*, *char spawning and rearing*, and *salmonid spawning and incubation.* The numeric water quality criteria established to protect those uses are summarized in Table 1.

---

[1] Available at:
http://yosemite.epa.gov/r10/water.nsf/Water+Quality+Standards/WQS+Temperature+Guidance/

Table 1. Washington State temperature criteria for impaired parameters in the South Fork Nooksack River watershed.

Use Classification	Criteria
Core summer salmonid habitat, spawning, rearing, and migration	< 16 °C 7-DADMax[a,b]
Char spawning and rearing	< 12 °C 7-DADMax[a,b]
Supplemental salmonid spawning and incubation	< 13 °C 7-DADMax[a,b] (Sept 1–Jul 1)

[a] 7-DADMax means the highest annual running 7-day average of daily maximum temperatures.
[b] A human-caused variation within the above range of less than 0.3 °C for temperature is acceptable.

Commented [SB2]: Include a map of the areas covered by each use classification and criteria

Washington State uses the criteria described above to ensure full protection for its designated aquatic life uses. The standards recognize, however, that not all waters are naturally capable of meeting the numeric temperature criteria. When a ~~water body~~waterbody is naturally warmer than the above-described numeric criteria, the state ~~provides a small~~limits the allowance for additional warming due to human activities. In this case, the combined effects of all human activities must not cause more than a 0.3 °C (0.54 °F) increase above the naturally warmer temperature condition.

When a ~~water body~~waterbody does not meet its assigned criteria due to natural climatic or landscape attributes, the standards also state that the natural conditions constitute the water quality criteria (WAC 173-201A-260 (1)(a). This TMDL estimates ~~W~~whether the ~~water body~~waterbody is naturally warmer or naturally cooler ~~is estimated in this TMDL~~ using a computer model that simulates the physical and atmospheric processes affecting stream temperatures.

Temperature modeling is generally a two-step process. First, the current river temperatures are measured through field monitoring. The watershed's current physical characteristics (e.g., amount of shade provided by the canopy, river geometry, sources of flows, significant cold water flows, point source inputs, etc) are also recorded. Using this information, a river model ~~of the watershed~~ is created that simulates ~~its~~ current temperature conditions. The model is ~~then~~ calibrated by comparing the simulated temperatures with ~~the actual~~in-stream measurements.

Second, the calibrated model is used to evaluate different scenarios – including a "system thermal potential" or "system potential" scenario that represents the natural condition of the river system. ~~In order to simulate the natural condition, p~~Physical characteristics of the river are changed in the model to simulate the natural condition. Examples of these changes include removing point source discharges ~~from the model inputs~~, changing the channel geometry to simulate a natural ~~condition~~channel, and increasing the riparian shade to represent a natural forest. ~~While modeling is not a complete representation of reality~~The model provides an effective ~~, it is a very effective tool for estimating~~ estimate of natural conditions in rivers and streams, especially in the absence of adequate data from non-disturbed reference conditions.

~~Because~~ The water quality model~~ing~~ is ~~not a complete representation of reality~~only an estimate of natural condition temperatures; therefore, a degree of uncertainty is inherent in the model results. Ecology addresses uncertainty in model applications using statistical measure for goodness-of-fit and incorporation of an implicit margin of safety. Critical conditions that are used for the evaluation of natural conditions incorporate uncertainty in major environmental variables (e.g. stream flows and meteorological conditions).

For this TMDL, Ecology also assessed the uncertainty of the natural condition estimates by assessing the water quality model's sensitivity to the following changes, as discussed in Section X and illustrates in Figures __ - ___.

(1) cooler headwater and tributary temperatures

(2) decreased channel width

(3) increased system potential vegetation height and riparian buffer width

(4) enhanced hyporheic exchange,

(5) the combined impact of all four alterations.

To the extent that these (non-discharge) influences on temperature have existed historically, or can be put in place now, these sensitivity analyses provide estimates of the variability associated with the natural condition estimates. This variability should be considered when making future impairment, land-use, permitting, or restoration decisions.